# Offer **AP® Precalculus** at Your School

2023-24 School Year



UPDATED NOV 17

Every student who is ready for high school precalculus is ready for **AP Precalculus**.

| | |
|---|---|
| **01** | **Students** |
| **02** | **Content** |
| **03** | **Resources** |
| **04** | **Why** |
| **05** | **Learn More** |

# Students

**All**

# Any Precalculus Student Can Be an AP Precalculus Student

## No Matter When They Take Algebra 1

| Grade 8 | Grade 9 | Grade 10 | Grade 11 | Grade 12 |
|---------|---------|----------|----------|----------|
| Algebra 1 | Geometry | Algebra 2 | **AP Precalculus** | AP Calculus AB |
| | | | | AP Calculus BC |
| | Algebra 1 | Geometry | Algebra 2 | **AP Precalculus** |
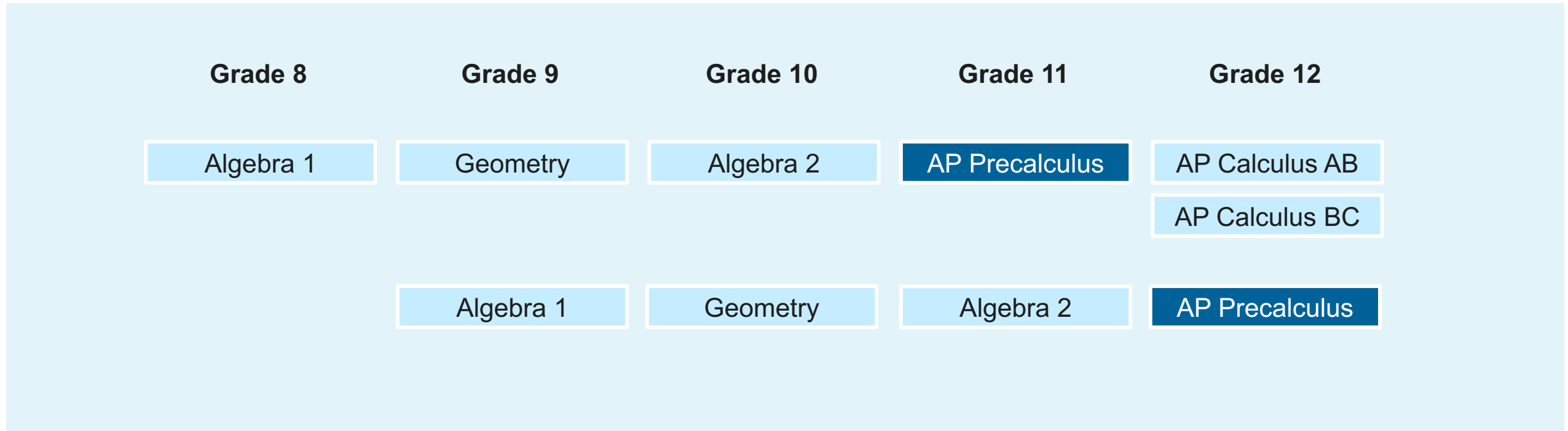
- AP Precalculus is designed for students who've taken Algebra 1, Geometry, and Algebra 2.
- That means **any precalculus student can be an AP Precalculus student**, no matter if they're finishing high school with AP Precalculus or using AP Precalculus to prepare for AP Calculus AB or BC.

# All 12 Prerequisites Are Taught in Prior Courses

**For Success in AP Precalculus**

| Expected Prior Knowledge and Skills | Algebra 1 | Geometry | Algebra 2 |
|---|:---:|:---:|:---:|
| Proficiency with linear functions | ✓ | ✓ | ✓ |
| Proficiency in polynomial addition and multiplication | ✓ | | ✓ |
| Proficiency in factoring quadratic trinomials | ✓ | | ✓ |
| Proficiency in using the quadratic formula | ✓ | | ✓ |
| Proficiency in solving right triangle problems involving trigonometry | | ✓ | ✓ |
| Proficiency in solving linear and quadratic equations and inequalities | ✓ | | ✓ |
| Proficiency in algebraic manipulation of linear equations and expressions | ✓ | ✓ | |
| Proficiency in solving systems of equations in two and three variables | ✓ | | ✓ |
| Familiarity with piecewise-defined functions | ✓ | | ✓ |
| Familiarity with exponential functions and rules for exponents | ✓ | | ✓ |
| Familiarity with radicals (e.g., square roots, cube roots) | ✓ | ✓ | |
| Familiarity with complex numbers | | | ✓ |

# AP Precalculus Fits Into All the Common Math Pathways

**Most students will take AP Precalculus as seniors, but some will take it earlier in prep for AP Calculus AB or BC.**

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5+ |
|---|---|---|---|---|
| Algebra 1 | Geometry | Algebra 2 | **AP Precalculus\*** | AP Calculus AB\*<br>AP Calculus BC\*^<br>AP Statistics\* |
| | | | AP Statistics | AP Calculus AB<br>AP Calculus BC<br>**AP Precalculus** |
| | | | AP Calculus AB | AP Calculus BC<br>AP Statistics |
| | Algebra 2 | Geometry | **AP Precalculus\***<br>AP Calculus AB<br>AP Statistics | AP Calculus AB\*<br>AP Calculus BC\*^<br>AP Statistics\* |
| | Geometry and Algebra 2 | **AP Precalculus\***<br>AP Statistics<br>AP Calculus AB | AP Calculus AB\*<br>AP Calculus BC\*^<br>AP Statistics | AP Calculus AB<br>AP Calculus BC<br>AP Statistics\* |

\* Represents an anticipated sequence for most students on this pathway.
^ It is anticipated that a higher percentage of students may pursue AP Calculus BC having had AP Precalculus due to topic coverage not found in some precalculus courses.

Note: The **Pre-AP** course sequence is Pre-AP Algebra 1, Pre-AP Geometry with Statistics, Pre-AP Algebra 2.

# AP Precalculus Fits Into All the Common Math Pathways

**Most students will take AP Precalculus as seniors, but some will take it earlier in prep for AP Calculus AB or BC.**

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5+ |
|---|---|---|---|---|
| Integrated Math 1 | Integrated Math 2 | Integrated Math 3 | **AP Precalculus*** | AP Calculus AB*<br>AP Calculus BC*^<br>AP Statistics* |
| | | | AP Statistics | AP Calculus AB<br>AP Calculus BC<br>**AP Precalculus** |
| | | | AP Calculus AB | AP Calculus BC<br>AP Statistics |

\* Represents an anticipated sequence for most students on this pathway.
^ It is anticipated that a higher percentage of students may pursue AP Calculus BC having had AP Precalculus due to topic coverage not found in some precalculus courses.

Note: The **Pre-AP** course sequence is Pre-AP Algebra 1, Pre-AP Geometry with Statistics, Pre-AP Algebra 2.

# You Can Replace Any Precalculus Section with AP Precalculus

**No Matter the Grade or Level**

AP Precalculus will prepare these students for AP Calculus AB or BC in Grade 12.

## Grade 11
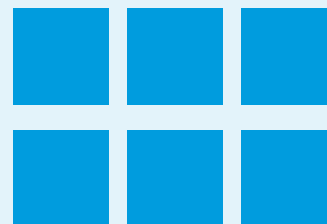Precalculus

Honors Sections:

Regular Sections:

## Grade 12
Precalculus

Honors Sections:

Regular Sections:

AP Precalculus will provide these students with the opportunity for college credit.

AP Precalculus can be taught from your existing textbooks. Students should get college credit for the college work they're already doing.

# Content
## Similar

# Similar Content: Precalculus is Precalculus

**AP Precalculus contains similar content as existing high school precalculus courses – which are, by their design, already advanced.**

## High School Precalculus

- ✓ Polynomial Functions
- ✓ Rational Functions
- ✓ Exponential Functions
- ✓ Logarithmic Functions
- ✓ Trigonometric Functions
- ✓ Polar Functions

**Varies** — Functions Involving Parameters, Vectors, and Matrices

## AP Precalculus

- ✓ Polynomial Functions
- ✓ Rational Functions
- ✓ Exponential Functions
- ✓ Logarithmic Functions
- ✓ Trigonometric Functions
- ✓ Polar Functions

**Local Option** — **Unit 4:** Functions Involving Parameters, Vectors, and Matrices*

## College Precalculus

- ✓ Polynomial Functions
- ✓ Rational Functions
- ✓ Exponential Functions
- ✓ Logarithmic Functions
- ✓ Trigonometric Functions
- ✓ Polar Functions

**Varies** — Functions Involving Parameters, Vectors, and Matrices

[!] *Unit 4 will <u>not</u> be assessed on the AP Precalculus Exam. It's provided in the course framework for teachers who'd like to include these topics.

# Course at a Glance

## AP Precalculus

| Unit 1 | Polynomial and Rational Functions |
|---|---|
| 1.1 | Change in Tandem |
| 1.2 | Rates of Change |
| 1.3 | Rates of Change in Linear and Quadratic Functions |
| 1.4 | Polynomial Functions and Rates of Change |
| 1.5 | Polynomial Functions and Complex Zeros |
| 1.6 | Polynomial Functions and End Behavior |
| 1.7 | Rational Functions and End Behavior |
| 1.8 | Rational Functions and Zeros |
| 1.9 | Rational Functions and Vertical Asymptotes |
| 1.10 | Rational Functions and Holes |
| 1.11 | Equivalent Representations of Polynomial and Rational Expressions |
| 1.12 | Transformations of Functions |
| 1.13 | Function Model Selection and Assumption Articulation |
| 1.14 | Function Model Construction and Application |

| Unit 2 | Exponential and Logarithmic Functions |
|---|---|
| 2.1 | Change in Arithmetic and Geometric Sequences |
| 2.2 | Change in Linear and Exponential Functions |
| 2.3 | Exponential Functions |
| 2.4 | Exponential Function Manipulation |
| 2.5 | Exponential Function Context and Data Modeling |
| 2.6 | Competing Function Model Validation |
| 2.7 | Composition of Functions |
| 2.8 | Inverse Functions |
| 2.9 | Logarithmic Expressions |
| 2.10 | Inverses of Exponential Functions |
| 2.11 | Logarithmic Functions |
| 2.12 | Logarithmic Function Manipulation |
| 2.13 | Exponential and Logarithmic Equations and Inequalities |
| 2.14 | Logarithmic Function Context and Data Modeling |
| 2.15 | Semi-log Plots |

| Unit 3 | Trigonometric and Polar Functions |
|---|---|
| 3.1 | Periodic Phenomena |
| 3.2 | Sine, Cosine, and Tangent |
| 3.3 | Sine and Cosine Function Values |
| 3.4 | Sine and Cosine Function Graphs |
| 3.5 | Sinusoidal Functions |
| 3.6 | Sinusoidal Function Transformations |
| 3.7 | Sinusoidal Function Context and Data Modeling |
| 3.8 | The Tangent Function |
| 3.9 | Inverse Trigonometric Functions |
| 3.10 | Trigonometric Equations and Inequalities |
| 3.11 | The Secant, Cosecant, and Cotangent Functions |
| 3.12 | Equivalent Representations of Trigonometric Functions |
| 3.13 | Trigonometry and Polar Coordinates |
| 3.14 | Polar Function Graphs |
| 3.15 | Rates of Change in Polar Functions |

☑

**Units 1-3** will be tested on the AP Precalculus Exam. These units are required by colleges for credit and placement into Calculus 1.

## Local discretion.

| Unit 4 | Functions Involving Parameters, Vectors, and Matrices |
|---|---|
| 4.1 | Parametric Functions |
| 4.2 | Parametric Functions Modeling Planar Motion |
| 4.3 | Parametric Functions and Rates of Change |
| 4.4 | Parametrically Defined Circles and Lines |
| 4.5 | Implicitly Defined Functions |
| 4.6 | Conic Sections |
| 4.7 | Parametrization of Implicitly Defined Functions |
| 4.8 | Vectors |
| 4.9 | Vector-Valued Functions |
| 4.10 | Matrices |
| 4.11 | The Inverse and Determinant of a Matrix |
| 4.12 | Linear Transformations and Matrices |
| 4.13 | Matrices as Functions |
| 4.14 | Matrices Modeling Contexts |

⊘

**Unit 4** will <u>not</u> be tested on the AP Precalculus Exam.

# Mathematical Practices

## AP Precalculus

The eight distinct skills are associated with three mathematical practices.

- Students should build and master these skills throughout the course.

- While many different skills can be applied to any one content topic, the framework supplies skill focus recommendations for each topic to help assure skill distribution throughout the course.

| Practice 1 | Practice 2 | Practice 3 |
|---|---|---|
| **Procedural and Symbolic Fluency**<br><br>Algebraically manipulate functions, equations, and expressions. | **Multiple Representations**<br><br>Translate mathematical information between representations. | **Communication and Reasoning**<br><br>Communicate with precise language, and provide rationales for conclusions. |
| **Skill 1.A: Solve equations and inequalities** represented analytically, with and without technology.<br><br>**Skill 1.B: Express** functions, equations, or expressions in analytically **equivalent forms** that are useful in a given mathematical or applied context.<br><br>**Skill 1.C: Construct new functions**, using transformations, compositions, inverses, or regressions, that may be useful in modeling contexts, criteria, or data, with and without technology. | **Skill 2.A: Identify information from** graphical, numerical, analytical, and verbal **representations** to answer a question or construct a model, with and without technology.<br><br>**Skill 2.B: Construct equivalent** graphical, numerical, analytical, and verbal **representations** of functions that are useful in a given mathematical or applied context, with and without technology. | **Skill 3.A: Describe** the **characteristics** of a function with varying levels of precision, depending on the function representation and available mathematical tools.<br><br>**Skill 3.B: Apply** numerical **results** in a given mathematical or applied context.<br><br>**Skill 3.C: Support conclusions** or choices with a logical rationale or appropriate data. |

# About the Exam

## AP Precalculus

- The AP Precalculus Exam assesses student understanding of the mathematical practices and learning objectives outlined in **Units 1-3** in the course framework.

- **The exam is 3 hours long and includes 40 multiple-choice questions and four 6-point free-response questions.**

- The details of the exam, including exam weighting, timing, and calculator requirements, can be found to the right.

| Section | Question Type | Number of Questions | Exam Weighting | Timing |
|---------|---------------|---------------------|----------------|--------|
| I | **MULTIPLE-CHOICE QUESTIONS** | | | |
| | Part A: Graphing calculator not permitted | 28 | 43.75% | 80 minutes |
| | Part B: Graphing calculator required | 12 | 18.75% | 40 minutes |
| II | **FREE-RESPONSE QUESTIONS** | | | |
| | Part A: Graphing calculator required | 2 | 18.75% | 30 minutes |
| | Part B: Graphing calculator not permitted | 2 | 18.75% | 30 minutes |

Reminder: **Unit 4** is not assessed on the AP Precalculus Exam.

# No Need to Switch: Use Your Existing Textbook

**Precalculus is precalculus**

**Continue to use your existing precalculus textbook**

- Teachers will find that the AP Precalculus course covers much of the same content as their existing precalculus course.

- They can continue to use their existing precalculus textbook, which is already college level, and follow along with the course and exam description.

- Free additional resources will be available in AP Classroom, including AP Daily videos and Personal Progress Checks.

# Technology Notes

**Technology should be used throughout the course as a tool to explore concepts.**

Students should specifically practice using technology to do the following:

- Perform calculations (e.g., exponents, roots, trigonometric values, logarithms)

- Graph functions and analyze graphs

- Generate a table of values for a function

- Find real zeros of functions

- Find points of intersection of graphs of functions

- Find minima/maxima of functions

- Find numerical solutions to equations in one variable

- Find regressions equations to model data

- Perform matrix operations (e.g., multiplication, finding inverses)

**Important**: Technology should not replace the development of symbolic manipulation skills.

- When algebraic expressions and equations are accessible with precalculus-level algebraic manipulation, students are expected to find zeros, solve equations, and calculate values without the help of technology.

- Most of the AP Exam will need to be completed without the use of technology. However, selected questions will require students to use a graphing calculator to complete the tasks delineated above.

# Resources

**More**

# AP Precalculus: More Time, Incentives, and Supports

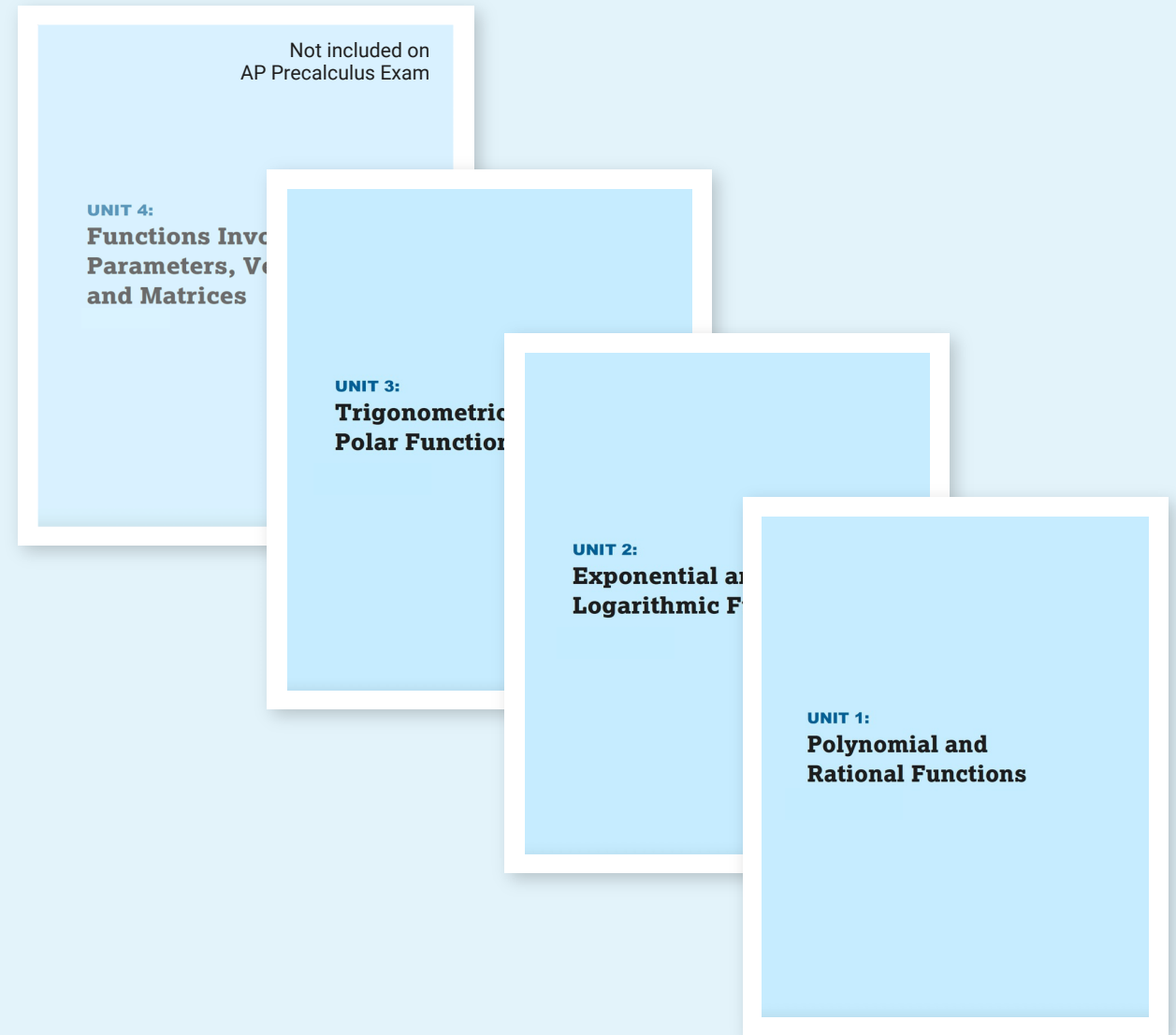| | **High School** Precalculus | **College** Precalculus | **AP Precalculus** |
|---|---|---|---|
| Functions Studied: | Polynomial / Rational | Polynomial / Rational | Polynomial / Rational |
| Functions Studied: | Exponential / Logarithmic | Exponential / Logarithmic | Exponential / Logarithmic |
| Functions Studied: | Trigonometric / Polar | Trigonometric / Polar | Trigonometric / Polar |
| Functions Studied: | Parameters / Vectors / Matrices* | Parameters / Vectors / Matrices* | Parameters / Vectors / Matrices |
| **Hours of Instruction:** | 140 hours | 48 hours | 140 hours |
| **Class Size:** | Small classroom | Large lecture hall | Small classroom |
| **Incentives:** | | | GPA bonus points |
| **Incentives:** | | | College credit opportunity |
| **Supports:** | | | AP Daily Videos |
| **Supports:** | | | Free AP Online Practice |
| **Supports:** | | | AP Teacher Workshops |

*In Most Courses*

# Free Unit Guides

## For AP Teachers

Each unit includes these features:

- Exploration, analysis, and application of **new function types**.

- Deep development of a **key function concept** applicable across function types such as transformations, compositions, and inverses.

- Examination of **how variables change relative to each other** for each of the function types.

- Use of each function type to **model contexts and data sets**.

- Rigorous application of the **algebraic skills** needed to engage with each function type.

Not included on
AP Precalculus Exam

**UNIT 4:**
**Functions Inv**
**Parameters, V**
**and Matrices**

**UNIT 3:**
**Trigonometric**
**Polar Function**

**UNIT 2:**
**Exponential a**
**Logarithmic F**

**UNIT 1:**
**Polynomial and**
**Rational Functions**

# Free Learning Resources in AP Classroom

## Key Features

**Topic Questions** are formative questions that teachers can use to check student understanding of content and skills as each topic is taught.

**Progress Checks** assess student understanding of topics and skill within a unit through multiple-choice and free-response questions.

**AP Daily** is a series of on-demand, short videos that teachers can assign to students*, saving direct class time to focus on areas where students need the most support.

The **My Reports** section can help teachers visualize student progress and prioritize areas for extra support by pinpointing strengths and weaknesses.

*AP Daily videos are always visible and available to all students, including students in Exam Only sections, regardless of whether teachers have assigned them. Topic Questions and Progress Checks are only visible to students if a teacher assigns them.

**AP teachers and students access AP Classroom by signing in at myap.collegeboard.org.**

# Additional Support for Teachers

## Professional Learning Opportunities

- Teachers can enroll in an **AP Summer Institute** (APSI) for Precalculus, a four-day professional learning experience that equips teachers with a deep understanding of the course framework, exam, and instructional supports.

- APSI scholarships will be available to teachers who qualify.

- Additional **one-day professional learning workshops** will also be available.

# Why

## Equity and Access

# Why AP Precalculus Matters

## Math Knowledge

100% of Students

**40%** **Insufficient** Math Knowledge
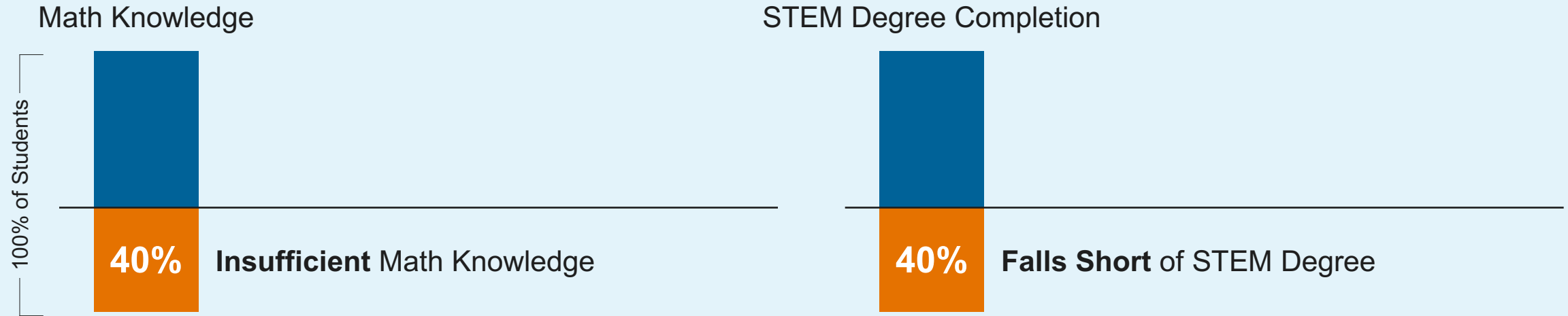
Looking across all majors, **40% of college students lack sufficient math in high school to enroll in college-level math courses**, so students must spend time and money on remedial math courses that do not count toward their degrees. Nearly half of these students fail to fulfill the math requirement.[1]

## STEM Degree Completion

**40%** **Falls Short** of STEM Degree

**40% of students who enter college as STEM majors switch to a non-STEM major or fall short of a degree after failing common gateway courses**, particularly calculus.[2]

[1] Chen, X. (2016). Remedial Coursetaking at U.S. Public 2- and 4-Year Institutions: Scope, Experiences, and Outcomes (NCES 2016-405). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved May 2022 from http://nces.ed.gov/pubsearch.

[2] https://www.nytimes.com/2011/11/06/education/edlife/why-science-majors-change-their-mind-its-just-so-darn-hard.html?pagewanted=all

# Students Get a Larger **Boost** with Precalculus

**Precalculus Is a Powerful High School Math Course**

Students who take precalculus in high school are

# 155%

**more likely to complete a bachelor's degree**[3], a higher boost in degree completion than students taking Algebra 2, Trigonometry, or Calculus.

[3] Trusty, J., & Niles, S. G. (2003). High-school math courses and completion of the bachelor's degree. Professional School Counseling, 7(2), 99–107.

# Benefits

What sets the course apart is the opportunity it gives students to **earn college credit** and placement for their work and **stand out in the admissions process**.

Qualifying AP Precalculus Exam scores can **fulfill a college math requirement**, so students can focus on courses most central to their major.

**For many seniors, taking AP Precalculus may be their only opportunity to experience AP before graduating high school.**

- Taking even one AP course changes student outcomes - greatly improving their first-year college GPA and on-time college graduation rates.

- Offering AP Precalculus, especially among those students who haven't yet taken any AP course, can be transformative.
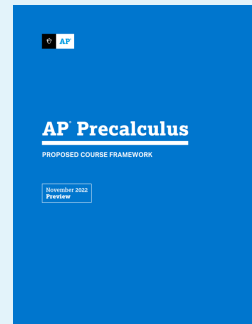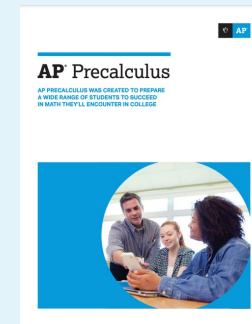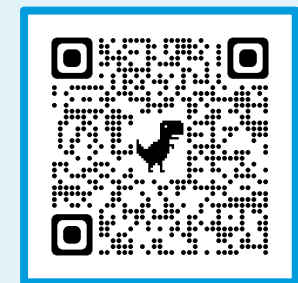
# Learn More

# About AP Precalculus



AP Central
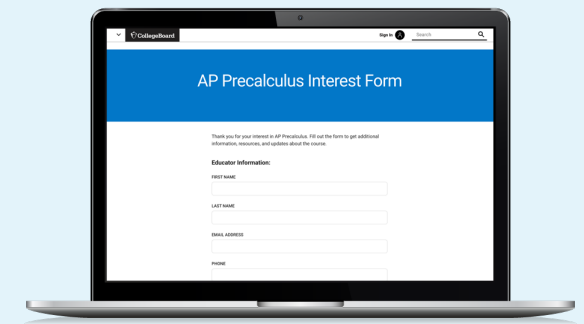


Course Framework
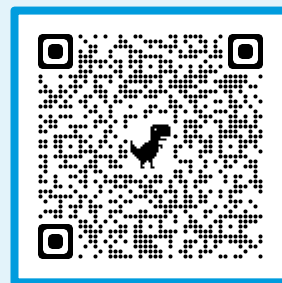


Brochure



Interest Form

# Download the **Introducing AP Precalculus** Presentation

## Presentation



Introducing
AP Precalculus

Launch Year: 2023-24
First Exam: May 2024

Fall 2022    UPDATED OCT 14

## Here's what's inside:

### Introducing AP Precalculus



**01 Why offer AP Precalculus?**
Inadequate Preparation for College Math, Benefits of AP Precalculus

**02 Who should take AP Precalculus?**
Algebra 1 in Grade 9, Algebra 1 in Grade 8, Majors/Careers Not Requiring Calculus

**03 What's in AP Precalculus?**
Student Experience, Unit Outline, Course at a Glance, Mathematical Practices

**04 Bring AP Precalculus to your school.**
Textbooks, Calculators, Teacher Supports, Student Readiness

Introducing AP Precalculus                                          3

Thank you.